process and criteria to address the needs and to identify which alternative, or alternatives best support the need for system improvements.

V. PLANNING PROCESS AND CRITERIA

A. PLANNING PROCESS

Q. WHAT ARE THE BASIC STEPS OF PLANNING AN ELECTRIC SYSTEM?

A. The basic steps of electric system planning include, but are not limited to:

1. Preparing load forecasts based upon pertinent, known data.
2. Analysis of the system under normal and contingency or stressed conditions.
3. Application of planning criteria to identify system weaknesses.
4. Formulation of various alternatives to correct system weaknesses based upon an iterative analysis process and engineering judgment.
5. Preparing cost estimates for each alternative and comparing alternatives in a cost vs. benefit analysis including risk assessment.
6. Pursuing recommended solutions for implementation.

Q. ARE HECO'S PLANNING PROCEDURES SIMILAR TO THESE PLANNING STEPS?

A. Yes. HECO describes their transmission planning steps on page 4, of HECO T-4. This summary is similar to the planning steps just described. It

should be noted, however, that HECO is limiting its planning to transmission projects (i.e., there is no mention of sub-transmission or distribution planning).

Q. WHAT ARE SOME IMPORTANT ISSUES THAT MUST BE CONSIDERED WHEN PLANNING AN ELECTRIC SYSTEM?

A. HECO's witness, Mr. Pollock provides a good summary of issues to consider on pages 4 and 5 of his testimony (HECO T-3), which are repeated here as follows:

1. Decisions must be made well in advance of the projected need date because permitting and construction of facilities and/or implementation of programs can take many years.

2. Decisions are long-term. Utility infrastructure will, with regular maintenance and component replacement, remain in service indefinitely, for all practical purposes.

3. Because planning decisions contemplate the installation of facilities such as substations, generation plants, and transmission lines that have a very long life, consideration must be given to the future electrical system as a whole, in addition to the solutions of the most immediate problems.

4. The analysis must be forward looking, with load forecasts based on the information available at the time of the study.

5. The system analysis is based on the measured and projected electrical load at each substation and existing/planned generation additions.

6. To facilitate financial and operation planning, the study recommendations that result based on specific load levels are translated to dates (year of need) based on load forecast.

7. The technical analysis is conducted based on previously approved planning criteria, applied with judgment, to arrive at recommendations.

8. Recommendations that result for the study must balance system performance, including reliability, against cost.

9. The study process is an ongoing activity to take into account the changes over time to the forecasted load levels in any given year. Thus planning studies must be performed on a regular basis to keep up the changes.

Q. ARE THERE OTHER CONSIDERATIONS THAT SHOULD BE INCLUDED IN THE ABOVE PLANNING PROCESS?

A. Absolutely. One important consideration that is not discussed by HECO is system utilization. Any electric system is capital intensive. The investments made in the system need to be utilized to the fullest potential to ensure the provision of reliable service at a reasonable cost. Transmission and generation plant is typically the most substantial financial investments in an electric system, followed by distribution substations and systems. For

purposes of this discussion, I will limit my points to transmission and distribution (where 46 kV is included in distribution).

Transmission facilities are designed to transport power over a distance from generation sources to electrical load centers. Distribution facilities are utilized to route that power requirement to specific end users via substations and distribution lines. The electric system should not only be planned to efficiently serve this function, but should be operated as such. To determine if a system is being operated efficiently, power engineers often review system utilization.

Q. WHAT IS MEANT BY SYSTEM UTILIZATION?

A. Electrical components have a certain rating or ability to conduct (transport) electrical current and power. These components consist of lines (conductors), transformers, breakers, etc. Electric conductors and transformers typically have a normal and emergency rating in MVA. When performing a load flow study, planners often look at what percentage, or utilization of ratings the major conductors and transformers are carrying under normal and emergency conditions.

Q. WHAT VALUABLE INFORMATION CAN BE OBTAINED BY LOOKING AT THE SYSTEM UTILIZATION?

A. System utilization can help system planners provide the following information:

1. Identifying any lines or transformers that are being over-utilized, that is, overloaded under normal and expected contingencies.
2. Identifying any lines or transformers that are being under-utilized, that is not loaded to a reasonable or expected percentage of equipment ratings.
3. Identifying problems with load distribution, such as lines or transformers in a certain area that are over-utilized, while lines and transformers in other areas are under-utilized.
4. Providing a gauge as to how much load growth potential is possible based on utilization of transformers, substations and lines.

Q. IN WHAT MANNER DOES A SYSTEM PLANNER REVIEW SYSTEM UTILIZATION?

A. Load flow analyses are utilized to review the loading percentage of components including lines, transformers and substations. The review is made on an individual basis and a group basis, such as capacity to a transmission or sub-transmission substation. The results are looked at under normal and contingency situations whenever possible to identify areas where corrective action is needed to ensure the provision of reliable service. Once these areas are identified, decisions as to the appropriate correction action to take can be made.

Q. HOW DO PLANNERS USE A SYSTEM UTILIZATION STUDY IN THE PLANNING PROCESS FOR PROJECTS SUCH AS THOSE PRESENTED IN THE INSTANT DOCKET?

A. System utilization is compared to planning criteria to determine if equipment is operating within the constraints of such criteria. Good planning considers utilizing equipment to the fullest extent while still within the bounds of planning criteria.

B. HECO PLANNING CRITERIA

Q. HAVE YOU REVIEWED HECO'S TRANSMISSION PLANNING CRITERIA AS IT RELATES TO THIS PROJECT?

A. Yes, I have reviewed the HECO planning criteria for reasonableness and as it relates to the project presented in the instant docket.

Q. COULD YOU PLEASE SUMMARIZE HECO'S CRITERIA FOR TRANSMISSION SYSTEM PLANNING?

A. HECO's Engineering Standard Practice, Section V, Subsection D, part 11.4 contains the criteria for transmission system planning (See HECO-406). HECO states, "The purpose of these criteria is to establish guidelines for planning a reliable transmission system for the island of Oahu." The document provides the criteria for making transmission additions, conditions for which the transmission system is planned, system loading limits, voltage

operating limits, crossing point considerations and other considerations. The premise of these guidelines is that the system must be able to serve the peak system load under normal and various contingency outages and maintain reliable operation (i.e., within prescribed loading and voltage limits).

Q. DO YOU FIND THE HECO TRANSMISSION PLANNING CRITERIA TO BE REASONABLE AS APPLIED TO HECO'S SYSTEM?

A. Yes, I find HECO's transmission planning criteria to be reasonable and consistent with the NERC Planning Standards. The criteria are not overly conservative, and are good guidelines for system planning.

Q. ONE OF HECO'S WITNESSES, MR. POLLOCK, DRAWS A CONCLUSION THAT THE HECO'S TRANSMISSION PLANNING CRITERIA ARE LESS STRINGENT THAN THE NERC PLANNING CRITERIA, DO YOU AGREE?

A. I find it difficult to draw a similar conclusion since it is comparing "apples to oranges" in some respects. The NERC standards are written for interconnected utility systems, whereas the HECO system is an island system. NERC's standards are written to allow reliable operation of a system with thousands of interconnected lines and generators. Since systems are interconnected, the standards must allow for multiple contingencies for reliable operation. NERC standards have the implicit assumption that the system will

not black out since the grid has so many interconnected lines between systems. The goals of the NERC standards are to minimize loss of load.

The HECO standards are written to allow the system, including the transmission system and generators, to safely and reliably operate to serve load, but also to ultimately survive multiple outages, even if load is lost. HECO's planning criteria cannot assume that the system will not black out under multiple line, or generator outages since the system is a relatively small island system. HECO's standards must therefore focus on maintaining system stability in addition to minimizing loss of load. Therefore, I conclude that HECO's standards are consistent with NERC, but have a somewhat different function to assure that the system will survive and that all loads may not continue to be served in serving.

Q. SINCE LOSS OF LOAD MAY OCCUR AS STATED IN THE HECO TRANSMISSION PLANNING CRITERIA, IS THE IMPORTANCE OF INTERRUPTING LOAD TO THE PUKELE SUBSTATION DISMISSED?

A. No, as stated above, the goals of the criteria are intended to have the system survive double contingency outages and also be able to serve load under such outage conditions. There is no argument that the Pukele substation load is important, just as loads from other substations are important. Therefore, HECO should take reasonable steps to make sure load at Pukele is reliably

served and that it is backed up if it is reasonable and just to do so. This is true system wide.

Q. HAVE YOU REVIEWED HECO'S CRITERIA FOR SUB-TRANSMISSION PLANNING?

A. Yes, I have reviewed the HECO sub-transmission planning criteria for reasonableness and as it relates to the project presented in the instant docket.

Q. COULD YOU PLEASE SUMMARIZE HECO'S CRITERIA FOR SUB-TRANSMISSION SYSTEM PLANNING?

A. HECO's Engineering Standard Practice, Section 7, Subsection D, part 11.5 contains the criteria for 46 kV sub-transmission system planning (see HECO response to CA-SIR-1). The document states, "The subtransmission system shall be planned on the basis of serving the predicted peak kva on any part of the system each year." The document provides the criteria for making subtransmission additions, normal and emergency operating conditions, loading limits, voltage limits, capacitor limits and other considerations.

The premise of these guidelines is that the 46 kV system must be able to serve the peak system load in specific areas under normal conditions and with only one line out in an area under emergency conditions, and maintain reliable operation (i.e., within prescribed loading and voltage limits). The 46 kV system is not planned for multiple circuit outages.

Q. DO YOU FIND HECO'S CRITERIA FOR SUB-TRANSMISSION CRITERIA PLANNING REASONABLE?

A. In general, I find HECO's subtransmission planning criteria to be reasonable. However, there seems to be some confusion regarding the planning of 46 kV circuits. In response to CA-IR-34, subpart c, HECO states:

> Therefore, in order to follow distribution criteria, which are used as a guideline to ensuring the reliability of the 46 kV sub-transmission systems, 46 kV circuits require the ability to automatically transfer to other circuits at the 46 kV substations . . . It is also preferred that that the 46 kV circuits serving as back-up circuits (as a result of automatic switching from one 46 kV circuit to the back-up) are served from a different transmission substation, where practical, without considering if there are two 138 kV feeds to the transmission substations that are serving the 46 kV substations. This provides added reliability to the 46 kV sub-transmission system if a problem should occur which affects the entire transmission substation (i.e., loss of 138 kV feeds to the transmission substation).

The above reference makes mention of "distribution" criteria versus sub-transmission criteria. Upon review of both the distribution and sub-transmission planning criteria, I was unable to find reference to the requirement for automatic switching of 46 kV circuits during emergencies, or the preference to feed 46 kV substations from alternate 138 kV sources during emergency automatic switching.

Therefore, it is unclear what methodology is being followed for the planning of backup 46 kV circuits. It appears that HECO is planning for backup of 46 kV circuits as stated in response to CA-IR-34, subpart c. HECO has numerous automatic 46 kV switches installed and later in that same

response, HECO indicates that over half of the 46 kV substations have separate 46 kV feeds from two different transmission substations. If this is the case, HECO's sub-transmission planning criteria should be amended to reflect this planning practice.

Q. PLEASE SUMMARIZE THE RESULTS OF YOUR REVIEW OF HECO'S PLANNING GUIDELINES AND CRITERIA.

A. In summary, I find the planning guidelines and criteria utilized by HECO to be reasonable. Transmission and sub-transmission planning criteria are consistent with NERC and typical of common planning standards.

Q. DOES THIS MEAN THAT THE INITIAL EOTP, WHICH CONSIDERED INSTALLING A 138 KV TRANSMISSION LINE, WAS PLANNED FOR PROPERLY AND THAT PROPER ANALYSES AND CRITERIA WERE UTILIZED TO DEVELOP THE PROJECT?

A. Absolutely not. Having written plans, procedures and criteria for planning does not automatically equate to the proper application of such processes. The question of whether HECO properly planned the initial EOTP will be answered in Section C. below, which examines the reasonableness of the initial EOPT in relation to the other alternatives considered by HECO.

For example, the fact that lower cost 46 kV system improvements proposed in this docket can address the major concerns identified by HECO

indicates that sub-transmission planning is either not being performed properly, or that sub-transmission projects were being ignored, or deferred in lieu of pursuing 138 kV alternatives. The result of distribution projects being ignored, or distribution planning not being properly performed is the same; system planning is lacking in that it does not incorporate both transmission, sub-transmission and distribution projects to best utilize the electric system (138kV, 46 kV and distribution).

C. APPLICATION OF PLANNING PROCEDURES AND CRITERIA TO HECO'S ELECTRIC SYSTEM.

Q. HOW DID YOU REVIEW THE PLANNING PROCEDURES AND CRITERIA OF HECO TO ASSESS THE REASONABLENESS OF EOTP COMPARED TO OTHER ALTERNATIVES ?

A. I applied HECO's planning methodology and criteria to identify what system improvements are needed on HECO's system. I previously concluded that system improvements, which increase system reliability to the Pukele Substation are most important at this time. In addition, I agree that HECO's planning process and criteria are reasonable. Therefore, I examined the HECO electric system on this premise.

Q. HOW DID YOU SPECIFICALLY COMPARE THE INITIAL 138 KV EOTP AND THE REVISED 46 KV EOTP WITH OTHER ALTERNATIVES?

A. As previously noted, numerous studies and load flow studies were examined. I then reviewed HECO's system utilization consistent with the procedures discussed earlier in this section of testimony. I then reviewed HECO's planning criteria along with the system utilization analysis to compare what system improvements are relevant for HECO's system at this time.

Q. ON WHAT PORTIONS OF HECO'S TRANSMISSION SYSTEM DID YOU PERFORM A SYSTEM UTILIZATION ANALYSIS?

A. I reviewed HECO's system utilization of transmission lines, and transmission substations (grouping of transformers) relevant to this docket.

Q. WHAT ARE THE RESULTS OF YOUR UTILIZATION REVIEW OF HECO'S TRANSMISSION LINES?

A. CA-107 shows the results of my review of HECO's load flow study, which represents the existing HECO electric system in 2007. From the table it is noted that under normal operations, the highest line load occurs on the CEIP to AES 138 KV line at 54% utilization of its normal 430 MVA rating, and 47.1% utilization of its emergency rating of 495 MVA. The Iwilei to School 138 kV line has the lowest utilization at 2.6% of its normal rating and 2.3% of its emergency rating of 331 MVA and 385 MVA, respectively.

Q. WHAT ARE THE RESULTS OF YOUR REVIEW OF THE TRANSMISSION SUBSTATIONS' (GROUPING OF TRANSFORMERS AT TRANSMISSION SUBSTATIONS) UTILIZATION ON HECO'S SYSTEM?

A. CA-108 shows the results of my review of the system in 2007 using data from HECO's load flow case. From this exhibit it is shown that the Kewalo Substation has the lowest substation utilization at 7.4% of its 50 MVA rating, and 6.2% of its emergency rating. The Pukele Substation has the highest utilization at 65% of normal ratings of 320 MVA and 49% of emergency ratings of 424 MVA.

Q. WHAT CONCLUSIONS DO YOU REACH AS A RESULT OF YOUR REVIEW OF HECO'S SYSTEM UTILIZATION?

A. I conclude that HECO has adequate available transmission and transmission substation transformation to serve load for some time (i.e., beyond 2022). Of greatest interest, is the obvious disparity in load distribution between the Koolau/Pukele Substations and other transmission substations in the area. For example, the Pukele and Koolau Substations are approximately 65% and 52% utilized, respectively while the Archer Substation is 37% utilized, the School Substation is 38% utilized and the Kewalo and Kamoku Substations are only 7% and 15% utilized, respectively under normal operations.

Additionally, I conclude that under normal transformer operating conditions, there is approximately 600 MVA of available transformer capacity

for growth and/or backup amongst the Archer, Koolau, Pukele, Kamoku, Kewalo, and School Street substations to serve east Oahu. If the criteria of having one transformer out of service at any time is considered a minimum of 200 MVA (this is a very conservative figure since it assumes that one transformer at each of these substations is out of service simultaneously) is available at these substations to serve load. If emergency ratings are used these figures increase substantially. The key point of this analysis is that HECO has available transmission and transformer capacity to serve existing and projected load growth in Downtown and East Oahu. These substations should have the load re-distributed to make better use (utilization) of the facilities that have been installed.

Q. DID YOU REVIEW HECO'S SUB-TRANSMISSION SYSTEM UTILIZATION?

A. No. As previously stated, the load flow models provided by HECO unfortunately do not include all 46 kV lines and distribution transformers, which are part of the sub-transmission system. However, I did review numerous switching diagrams provided by HECO in response to CA-IR-15, part c, which have conductor sizing and distribution transformer information. My review focused on available ways to move load from the Koolau/Pukele load center to the downtown load centers. This was previously discussed in Section IV. A. of my testimony. In general, the review of the switching diagrams indicates that there are actions HECO can take now to relieve some loading concerns at the

Pukele/Koolau substations. One simple example is that HECO indicates on page 38 of HECO T-4, that at the present time they can backup 7% of the Pukele Substation load from the Archer Substation. This translates into approximately 13 MW that HECO could transfer from the Pukele to Archer substation at this time.

Q. WHAT SHOULD BE THE GOALS OF SYSTEM PLANNERS WHEN APPLYING THE RESULTS OF A SYSTEM UTILIZATION ANALYSIS?

A. Ideally, the results of system utilization analysis are used to better distribute and utilize the existing infrastructure. Some ways to do this are as follows:

1. Sub-transmission lines should be loaded to approximately 50% of capacity to allow the circuit to back up another circuit.
2. Transformers should be loaded in accordance with transmission planning criteria and to allow adequate MVA to provide back up to interconnected circuits.
3. Transmission substations loading should allow for the outage of one transmission transformer without loss of load, or overloading the remaining transformer(s) beyond emergency limits.

Q. ARE THESE RESULTS OBTAINABLE?

A. Ideal results are not easy to obtain. There are factors such as geographic distribution of load, load density in areas, types of customers served,

impediments to building facilities in specific areas and other factors which influence the ability of a system to have ideal load distribution and system utilization. As will be shown, however, the current 46 kV EOTP, which is the subject of this proceeding, provides much better load distribution amongst the Pukele, Archer and Kamoku Substations.

Q. WHAT CONCLUSION DO YOU REACH REGARDING HECO'S SYSTEM AND THE ABILITY TO APPLY THE RESULTS OF THE LOAD UTILIZATION ANALYSIS?

A. HECO is adequately utilizing the Koolau/Pukele Substations and under-utilizing the Archer, School, Kewalo and Kamoku substations. This points to an obvious fact that there is unequal load distribution on HECO's 46 KV system and that equipment is being underutilized. This provides planners with an indication that improvements, which better utilize the existing transmission system substations transformers, will lead to better utilization of equipment. Further, 46 kV improvements are a likely choice to accomplish this goal.

Q. WHAT DO YOU CONCLUDE WHEN YOU APPLY HECO'S PLANNING CRITERIA TO THE ELECTRIC SYSTEM, CONSIDERING THE ABOVE SYSTEM UTILIZATION ANALYSIS?

A. Beginning with the 46 kV system, I conclude that if improvements are made on the 46 kV system consistent with sub-transmission planning criteria, load distribution will be more balanced amongst the Pukele Substation and downtown substations that are not being fully utilized. (For review purposes, this concept is reflected on exhibit CA-106). This, in turn, would affect the transmission system utilization. If load were more equally distributed amongst the downtown substation and the Pukele Substation, the Koolau/Pukele Overload Concern would no longer exist.

If 46 kV improvements are made such that all 46 kV Pukele Circuits have a back up circuit from another transmission substation, consistent with HECO's sub-transmission planning criteria, the Pukele Reliability Concern would not exist. This same criteria also greatly diminishes the Downtown Reliability Concern since the downtown substations could be backed up by the Pukele and Koolau Substations. The downtown overload situation can also be deferred or eliminated since load can be shifted to Pukele/Koolau substations during maintenance of the downtown 138 KV transmission lines. Simple application of proper planning criteria quickly indicates that both transmission and sub-transmission planning criteria and execution of these criteria are necessary for proper system planning to occur. Transmission and

sub-transmission planning criteria are uniquely different, but both are necessary.

Q. WHAT IS IMPORTANT TO RECOGNIZE ABOUT THE PLANNING OF TRANSMISSION SYSTEMS VERSUS SUB-TRANSMISSION SYSTEMS?

A. Although the 138 kV and 46 kV systems are planned differently as just described, projects that are implemented on either system impact the other. Both have minimum planning criteria, which cannot be ignored. Failing to improve the sub-transmission system leads not only to problems on the 46 kV systems, but as in this case, it can lead to problems on the transmission system.

This can best be explained by examining the projects discussed in the instant docket. From a transmission system planner's point of view, one could conclude that there is a reasonable case to install 138 kV improvements given the Koolau/Pukele Overload Situation and the Pukele Substation Reliability Concern. After all, the Pukele Substation has the highest system load at 205 MW and no existing means for the power to be backed up. If this problem is examined by itself, the easy answer is that new transmission capacity is needed. Application of the transmission system could be properly applied to show a case for 138 kV improvements. If no major distribution projects are planned to relieve load at a transmission substation, there is but one alternative, which is construction of 138 kV infrastructure.

On the other hand, from a sub-transmission systems planner's point of view, one could analyze the system in and around the Pukele Substation and find it difficult to find ways to backup circuits from the Pukele Substation with other transmission substations in past years. The School, Iwilei and Archer Substations were all available (prior to construction of the Kewalo and Kamoku Substations) to backup the Pukele load, but the 46 kV sub-transmission lines in the area were not sufficient to transfer load from the Pukele Substation to the School Street, Iwilei and Archer Substations.

Application of sub-transmission criteria and review of transmission substation utilization would lead the planner to conclude that stronger ties are needed to backup the Pukele Substation load. Analysis of the system would show that the Archer Substation should be utilized as a backup to the Pukele Substation. It might further have been concluded that the Archer Substation cannot backup the entire Pukele load and that ties need to be strengthened to additional substations such as the School and Iwilei Substations. If these ties were not practical to make, then perhaps studies would have shown that the Kamoku Substation 138/46 kV transformer and lines proposed in the instant docket were needed.

These are hindsight conclusions in my case, but should have been foresight conclusions of HECO. If planning included both transmission and sub-transmission distribution systems simultaneously, I contend that the results of that planning process would be very similar to the project HECO is

pursuing approval for in this docket. This same argument can be extended to distribution planning and criteria, which, in turn, impact sub-transmission projects and transmission projects. However, this proceeding did not include a review of the distribution systems.

Q. IS THERE OTHER EVIDENCE THAT A GAP EXISTS BETWEEN HECO'S TRANSMISSION SYSTEM AND SUB-TRANSMISSION/DISTRIBUTION SYSTEM PLANNING?

A. Yes. HECO's response to CA-IR-34, subpart a, clearly indicates that HECO did not incorporate a very major distribution study in the analysis to support the EOTP. This study, the *Kakaako Master Plan,* planned for approximately 265 MW of growth in the Kakaako area. Yet, HECO did not incorporate this very large project plan into the EOTP plans, even though the project included extensive work at the two major substations (Archer and Kaewe (Kamoku developed instead)) HECO wants to utilize for the Kamoku 46 kV Underground Alternative – Expanded project.

In addition, as previously noted in my testimony the Kakaako Master Plan did not incorporate transmission considerations in the study. Page 5 of the Kakaako Master Plan states, "Generation and Transmission system requirements also need to be addressed. However, they are beyond the scope of this study and will be discussed in other studies." The plan correctly identified the need to be incorporated into transmission plans, but transmission

plans ignored the study (response to CA-IR-34, subpart a.). Once again, had transmission and distribution planning efforts been incorporated, the outcome would have likely been similar to the project proposed in the instant docket.

Q. WHAT IS THE KEY CONCLUSION REGARDING HECO'S PLANNING PROCESS IN THE INSTANT DOCKET.

A. HECO's planning process failed to incorporate a complete system planning approach. The Company's approach of planning the system considering transmission impacts without considering the sub-transmission system planning and utilization led down an expensive path of pursuing the 138 kV Kamoku-Pukele Underground Alternative (via Waahila Ridge). Had the company exercised proper planning techniques for the entire electric system, including the 46 kV transmission systems, the concern raised in the instant docket with the Company's pursuit of the initial 138 kV EOTP would not exist. Therefore, I conclude that HECO stubbornly pursued the Kamoku-Pukele 138 kV Underground Alternative (via Waahila Ridge).

Q. DO YOU ALSO CONCLUDE THAT 46 KV IMPROVEMENTS ARE MORE APPROPRIATE FOR HECO'S SYSTEM AT THIS TIME?

A. Yes, improvements of the 46 kV sub-transmission systems are the greatest relevance at this time. Improvements of the 46 kV systems appear to have been ignored or delayed for some time as HECO pursued the 138 kV

alternative from the Pukele to Kamoku Substations. Construction of 46 kV facilities capable of having backup from a second transmission substation is consistent with HECO's planning criteria and HECO's preferred way of feeding important system loads. This planning criteria is a very common practice among most major (and smaller) utilities and is a recommended industry practice. Therefore, HECO should have been pursuing projects to meet this planning criterion for backup of major system load. So it is easy to recommend that 46 kV system improvements should be implemented.

Q. ARE THERE WAYS THAT HECO CAN BETTER PLAN THE ELECTRIC SYSTEM AT THIS TIME?

A. Yes. A complete planning process can be implemented anytime by incorporating transmission, sub-transmission and distribution plans and studies into a common planning process that allows proper integration of each system's planning criteria and the impacts upon one another.

Q. IS THERE AN EXISTING FRAMEWORK WITHIN WHICH HECO CAN IMPLEMENT SUCH A PLANNING PROCESS?

A. Not at the moment. However, it is suggested that the Commission consider the IRP Framework to help HECO implement such a planning process. The IRP Framework currently does not require transmission and distribution impacts to be specifically included in the planning process. This would be an

appropriate forum to ensure that HECO is properly planning all aspects of the electric system (i.e., generation and transmission and distribution or production and delivery).

Q. SPECIFICALLY, HOW SHOULD TRANSMISSION, SUB-TRANSMISSION AND DISTRIBUTION PLANS BE INCORPORATED INTO THE IRP PLANNING PROCESS?

A. Currently, the IRP process requires HECO to conduct a major IRP plan review every three years. Each review includes a 20-year planning horizon. The process is then repeated every three years at which time a new IRP plan is submitted.[6]

Within the IRP framework, the PUC could require that HECO also present detailed plans for major distribution, sub-transmission and transmission projects. These plans should be required to demonstrate system utilization and impacts upon each segment (transmission, distribution and sub-transmission). In doing so, Company plans will also more appropriately consider transmission impacts upon supply- and demand-side resource projects, which is consistent with HECO's transmission planning criteria.

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6 Summarized from *A Framework for Integrated Resource Planning (IRP Framework)* from PUC Decision and Order No. 11630, May 22, 1992, Docket No. 6617.

Q. DO YOU RECOMMEND THAT THIS ACTION BE TAKEN IN THIS PROCEEDING?

A. Yes, I assert that it is appropriate to require that the Company to incorporate transmission, sub-transmission and planning studies into the IRP Framework at this time.

VI. KAMOKU 46 KV UNDERGROUND ALTERNATIVE – EXPANDED

A. PROJECT BENEFITS AND REASONABLENESS

Q. HAVE YOU REVIEWED THE IMPROVEMENTS PROPOSED IN THE INSTANT DOCKET KNOWN AS THE "KAMOKU 46 KV UNDERGROUND ALTERNATIVE-EXPANDED"?

A. Yes. I have reviewed several documents and load flow studies related to this project. This review included:

1. The *2003 East Oahu Alternatives Study (December 2003)* and related load flow studies.
2. The *East Oahu Project: Option to the Koolau/Pukele Transmission Line Overload Problem (December 2003)* and related load flow studies.
3. The *East Oahu Transmission Project 46kV Phase Project, Draft Environmental Assessment*
4. The *East Oahu Transmission Project 46kV Phase Project, Final Environmental Assessment*

In addition to reviewing the documents noted above and HECO's load flow studies, I also toured the specific routing of the subject project during an August 9, 2004 meeting with HECO representatives.

Q. REGARDING THE BENEFITS AND REASONABLENESS OF THE EOTP AS PROPOSED, WHAT WERE THE SPECIFIC TOPICS OF YOUR REVIEW OF THE KAMOKU 46 KV UNDERGROUND ALTERNATIVE-EXPANDED PROJECT?

A. My review focused on Issue No. 2 in Order No. 20968.

Q. PLEASE SUMMARIZE THE KAMOKU 46 KV UNDERGROUND ALTERNATIVE-EXPANDED PROJECT.

A. HECO provides numerous detailed descriptions of the project in various studies and testimony. Therefore, details of the project will not be repeated here. In summary, the project consists of two phases. Phase 1 consists of installing 0.5 miles of underground 46 kV sub-transmission facilities and modifications at eight substations to interconnect three Pukele 46 kV circuits with circuits from the Archer and Kamoku Substations. Phase 2 involves installing 1.9 miles of underground 46 kV facilities and modifications at one substation, to interconnect four out of five of the remaining Pukele 46 kV circuits to the Archer and Kamoku Substations.

Q. WHAT ARE THE SPECIFIC BENEFITS HECO CLAIMS THE KAMOKU 46 KV UNDERGROUND ALTERNATIVE-EXPANDED WILL PROVIDE?

A. Table 3-5 on page 3-38 of the *East Oahu Transmission Project 46 kV Phased Project, Final Environmental Assessment* (Final EA), summarizes the benefits of the project. The highlights of the project are:

1. Phase 1 permanently moves 80 MW from the Pukele Substation to the Archer and Kamoku Substations.
   - This effectively eliminates the Koolau/Pukele Overload Situation.
   - 71 MW of this load can be transferred back to the Pukele Substation to partially address the Downtown Overload Situation.
2. Phase 1 allows an additional 63 MW (above the 80 MW permanently moved from Pukele) to be automatically transferred to Koolau circuits.
   - This partially addresses the Pukele Substation Reliability Concern.
3. Phase 1 allows the remaining 53 MW of the Pukele Substation load to be manually switched to the Koolau Substation circuits.
   - This provides at least some outlet to backup remaining Pukele loads in the event of an extended outage.
4. Phase 1 provides backup from the Pukele Substation to 38 MW of load served by the downtown substations' load.
   - This partially addresses the Downtown Substation Reliability Concern

5. Phase 2 provides automatic backup to the remaining 53 MW of the Pukele Substation is not addressed in Phase 1.

- This effectively eliminates the Pukele Substation Reliability Concern.
- Pukele can now use these same circuits to backup downtown circuits from Archer to further address the Downtown Substation Reliability Concern.

Q. DO YOU AGREE THAT THE INSTANT 46 KV PROJECT PROVIDES THE BENEFITS STATED BY HECO?

A. Yes. Review of load flow studies, switching diagrams of the 46 kV system and various system studies confirms that the Kamoku 46 kV Underground Alternative – Expanded provides the system benefits claimed by HECO.

Q. ARE THERE OTHER BENEFITS THAT THE KAMOKU 46 KV UNDERGROUND ALTERNATIVE-EXPANDED PROJECT PROVIDES?

A. Yes, the project provides better load distribution between the Koolau/Pukele service area and the downtown service area. The 138 kV lines from the Archer to Kewalo Substations and from the Kewalo to Kamoku Substations will be better utilized. The Archer and Kamoku Substations will both be better utilized. However, installation of a new 80 MVA 138/46 kV is required at the Kamoku Substation for Phase 1, in addition to the existing 138/25 kV 50 MVA

transformer already installed at the Kamoku Substation. At the Archer Substation, Phase 2 plans also call for a 138/46 kV, 80 MVA transformer, in addition to three existing 138/46 kV, 83 MVA transformer already installed at Archer Substation. Therefore, these two substations (Archer and Kamoku) will remain substantially underutilized once this new transformation is installed.

Q. WHAT ARE HECO'S REASONS FOR INSTALLING THESE 138/46 KV TRANSFORMERS AT THE ARCHER AND KAMOKU SUBSTATIONS?

A. At the Kamoku Substation, there are no existing 46 kV facilities. In order to create tie circuits from the Kamoku to Pukele Substations, 138/46 kV transformation must be installed. New 46 kV circuits from the Kamoku Substation can then be utilized to serve 46 kV load in areas that are now served by the Pukele Substation.

In the case of the Archer Substation, it appears that HECO finds it necessary to have "duplication of facilities." In other words, this transformer would be utilized to provide backup capacity to serve the entire Pukele Substation load in the event of a complete loss of the Pukele Substation (similar to the March 3, 2004 Pukele Substation outage).

Q. IS THE 138/46 KV, 80 MVA TRANSFORMER AND RELATED EQUIPMENT PROPOSED AT THE KAMOKU SUBSTATION IN PHASE 1 REQUIRED TO DERIVE THE BENEFITS OF THE PROPOSED PROJECT?

A. Yes, as explained, there are no 46 kV facilities at the Kamoku Substation. Therefore, this equipment is required to accomplish the project benefits. New 46 kV sub-transmission lines originating at the Kamoku Substation will tie to Pukele 46 kV circuits which currently exist.

Q. IS THE 138/46 KV, 80 MVA TRANSFORMER AND RELATED EQUIPMENT PROPOSED FOR THE ARCHER SUBSTATION IN PHASE 2 OF THE PROJECT REQUIRED TO DERIVE THE BENEFITS OF THE PROPOSED PROJECT?

A. No. In my review of the load flow cases and transformer utilization as it applies to the Kamoku 46 kV Underground Alternative – Expanded, I find that an additional transformer at Archer Substation is not necessary at this time.

Q. HOW DID YOU REACH THIS CONCLUSION?

A. I reviewed the load flow cases "LS2007DA.raw," "LS2012DC.raw," "LS2017DC.raw" and "LS2022DB.raw," which correspond to the Kamoku 46 kV Underground Alternative –Expanded (proposed project) in the years 2007, 2012, 2017 and 2022, respectively. These cases are from the *2003 East Oahu Alternatives Study (December 2003)* study and reflect the new load

distributions of the Pukele, Archer and Kamoku substations per the assumed project. CA-112 shows the substation utilization of pertinent substations assuming the proposed project is implemented.

In 2007, the combined load of the Pukele and Archer Substations is 264 MVA (246 MW). This figure grows to 277 MVA (268 MW) in 2022. If it is assumed that all of the Pukele Substation load is transferred to the Archer Substation, then transformers at Archer must be able to handle this additional load. Existing transformers have a combined normal rating of 249 MVA, and an emergency rating of 330 MVA. Even if the combined load figure of 277 MVA (277 MW) for the Archer and Pukele Substations in 2022 is utilized, the emergency ratings of the transformers at the Archer Substation are not exceeded. If the emergency rating at the Archer Substation occurs, HECO indicates that they can transfer 54 MW of this load to Koolau to reduce transformer loading to below emergency and normal ratings. As a result, the additional 138 kV transformer proposed to be installed at the Archer Substation is not required at this time.

Q. PLEASE SUMMARIZE YOUR FINDINGS REGARDING THE BENEFITS OF THE EOTP AS PROPOSED.

A. The Kamoku 46 kV Underground Alternative – Expanded provides the benefits as communicated by HECO. However, the 138/46 kV, 80 MVA transformer at

Archer Substation is not necessary to achieve the goals of this project at this time.

B. ROUTING, LOCATION, CONFIGURATION AND METHOD OF CONSTRUCTION

Q. HAVE YOU REVIEWED THE PROPOSED UNDERGROUND ROUTES, LOCATIONS OF FACILITIES AND METHODS OF CONSTRUCTION FOR PHASE 1 AND PHASE 2 OF THE EOTP?

A. Yes, I have reviewed numerous documents including direct testimony, planning studies and the ETOP Environmental Assessment (EA).

Q. WHAT CONCLUSIONS DO YOU REACH REGARDING THE ROUTING, FACILITY LOCATIONS AND METHODS OF CONSTRUCTION FOR THE EOTP?

A. HECO has placed a great deal of time and effort into the development of the EA and related documents regarding the construction of the EOTP as proposed. In my review of these documents, I find that the major construction issues related to the routing, facility locations and methods of construction have to do with working beneath existing Honolulu city streets.

There are a couple of issues that still need resolutions, such as whether or not certain streets will need to be completely repaved, or whether horizontal directional drilling will be utilized for installation of some of the facilities.

Q. WHAT CITY STREETS MAY NEED TO BE REPAVED AND WHY?

A. A new City directive may require HECO to pave streets along the project route from curb-to-curb, and not just in the area of installed duct lines. These Streets include Makaloa Street, Lime Street, Pumehana Street, Date Street, Winam Avenue and Mooheau Avenue in Phase 1. In Phase 2, this would include Cooke Street, King Street and McCully Street (HECO ST-2, pages 8 through 10). It is not anticipated that these requirements would affect the project schedule significantly.

Q. WHERE WOULD HORIZONTAL DIRECTIONAL DRILLING BE UTILIZED ON THIS PROJECT, IF REQUIRED?

A. Horizontal directional drilling would be done along King Street from Cooke Street to Punahou Street for Phase 2 only. Table 3-3 on page 3-25 of the final EA report indicates that this work would take an additional one to two months to complete versus conventional trenching.

Q. ARE EITHER OF THIS ITEMS MAJOR PROJECT IMPEDIMENTS?

A. No. These are normal decisions and details of a project this size that need to be worked out in the construction phase. Neither will cause significant delays, but both will add costs.

VII. COMPARISON OF THE KAMOKU 46 KV UNDERGROUND ALTERNATIVE – EXPANDED VERSUS OTHER 138 KV AND 46 KV ALTERNATIVES

Q. HAVE YOU COMPARED THE EOTP AS PROPOSED WITH OTHER 138 KV AND 46 KV ALTERNATIVES?

A. Yes, specifically, I reviewed various 138 kV and 46 kV alternatives in the context of Issue No. 3 from Order 20968. The analysis and conclusions regarding each of the eight items to be considered in addressing Issue No. 3 will be discussed in the sections below.

A. COST

Q. HOW DOES the COST OF THE KAMOKU 46 KV UNDERGROUND ALTERNATIVE – EXPANDED PROJECT COMPARE WITH OTHER ALTERNATIVES CONSIDERED BY HECO TO RELIEVE TRANSMISSION CONSTRAINTS?

A. Exhibit HECO-101 indicates that the Kamoku 46 kV Underground Alternative Expanded at $59 million, is roughly ½ the cost of the Kamoku-Pukele 138 kV Underground Alternative estimated at $110 to $122 million. The Kamoku 46 kV- Expanded is approximately $18 million higher than the Kamoku 46 kV Underground Alternative considered by HECO.

Numerous other projects were also considered. The *East Oahu Transmission Project Alternatives Study Update* (HECO, December, 2003) contains a comparison of nine total projects (five 138 kV and four 46 kV) considered to relieve transmission constraints. Table 5-1 of that study shows

138 kV options ranging from $109 million for the Kamoku-Pukele 138 kV XLPE Option to $280 million for the School-Pukele and School-Kamoku 138 kV Lines. The 46 kV options ranged from $41 million for the Kamoku 46 kV Underground Alternative to $115 million for the 46 kV Network Alternative.

Q. DO THESE COSTS ACCURATELY COMPARE THE 138 KV ALTERNATIVES WITH THE 46 KV ALTERNATIVES?

A. Not completely. The 46 kV alternatives include unusually high planning costs. This is due to HECO including the planning, public scoping and input, routing selection, environmental impact studies and the CDUP process for the initial 138 kV proposal in the 46 kV projects cost estimates (see HECO's response to CA-IR-36, part A). A more accurate comparison of project costs would be to reflect a cost comparison without those 138 kV planning costs included in the 46 kV alternatives.

In addition, HECO has made changes to the EOTP (as proposed) cost estimates as detailed in ST-9. Changes in the project route and other details increased the project total to $55,644,000 (ST-9, page 7). There is also the possibility that HECO will have to do additional road paving that would increase the project cost to approximately $60,910,000.

Q. WHAT AMOUNT OF 138 KV PLANNING COSTS DID HECO INCLUDE IN THE COST ESTIMATES FOR THE 46 KV ALTERNATIVES?

A. HECO's response to CA-IR-36 indicates that HECO included approximately $12 million for 138 kV planning related costs.

Q. HOW DO THE ALTERNATIVES COMPARE IF THIS $12 MILLION IS EXCLUDED FROM THE 46 KV ALTERNATIVES?

A. The EOTP as proposed would be reduced to $47 million and the 46 kV Underground Alternative would be reduced to approximately $29 million. The following table summarizes this comparison of costs for the three alternatives considered by HECO in the instant docket:

	Kamoku-Pukele 138 kV UG	**Kamoku 46 kV UG**	**Kamoku 46 kV UG Expanded**
Original Estimate	$109M to $122 M	$40.6 M	$55.6M to $61M
Reduction for 138 kV Planning	N/A	($12 M)	($12 M)
Adjusted Total	**$109M to $122 M**	**$28.6 M**	**$43.6 M to $49M**

Q. SHOULD THESE 138 KV PLANNING COSTS FOR THE INITIAL 138 KV PROPOSED EOTP BE EXCLUDED FROM THE 46 KV ALTERNATIVES?

A. Absolutely. As previously explained, it is my conclusion that had HECO properly planned and addressed concerns on the 46 kV sub-transmission system and properly applied planning criteria, the Kamoku 46 kV Underground

Alternative – Expanded should have been the project which was pursued from the beginning, instead of the 138 kV proposal HECO pursued.

Understanding, and more importantly, adhering to both transmission and sub-transmission planning criteria and reasonable planning practices is crucial for proper system planning. Not adhering to standards or failing to pursue obvious projects that are for the betterment of the system (i.e., reinforcing Pukele 46 kV ties to other substations) can be very costly. Had HECO implemented the guideline of having backup of 46 kV circuits, preferably from other transmission substations, and more importantly planned sub-transmission improvements along with transmission improvements, plans to provide reliable service to East Oahu customers could well have been completed by now. There is a very important conclusion to be pointed out. "Putting off" 46 kV projects in lieu of pursuing 138 kV projects is not a recommended planning practice. This leads to a lopsided approach to system planning as we have in this case.

The benefit of hindsight provides an unfair advantage for critiquing past decisions. However, had HECO looked into 46 kV alternatives when transmission issues were raised, analysis should have shown that a project involving 46 kV improvements to provide backup to the Pukele load and for the Pukele/Koolau Substations to provide backup to some downtown load, would have been the lowest cost, easiest to implement projects. The studies may have also concluded that additional sources (what is now the Kewalo and

Kamoku Substations) were needed. I conclude that the Kamoku-Pukele 138 kV Underground Alternative was not needed at the time it was pursued since more appropriate 46 kV measures that should have been pursued.

Q. WHAT SHOULD THE COMMISSION DO REGARDING THESE 138 KV COSTS INCLUDED IN THE 46 KV COST ESTIMATES?

A. The Commission should require the Company to expense the costs that are not related to the instant 46 kV project and exclude them from inclusion in the present EOTP costs. The reason is because the costs would not have been incurred if HECO had properly planned for the necessary improvements to the electrical system.

Q. ARE THERE OTHER COST ADJUSTMENTS THAT SHOULD BE CONSIDERED IN THIS PROCEEDING?

A. Yes, my testimony demonstrates that the 138/46 kV, 80 MVA transformer and related equipment proposed in Phase 2 at Archer Substation, is not necessary to derive the project benefits and should be excluded from project costs.

Q. WHAT ARE THE COSTS OF THE 138/46 KV TRANSFORMER AND RELATED EQUIPMENT THAT SHOULD BE ELIMINATED FROM THE COST ESTIMATES?

A. Exhibit HECO-901 contains estimated costs for the 138/46 kV transformers, 138 kV breakers and relay panels associated with the transformer. The cost of the transformer is approximately $1,000,000. The 138 kV breaker is $600,000 and the relay panel is $25,000. This amounts to approximately $1.6 million, which should be excluded from the EOTP cost estimates.

Q. PLEASE SUMMARIZE YOUR PROPOSED COST ADJUSTMENTS FOR THE EOTP?

A. The following is my proposed adjustments to the EOTP:

Project Estimate:	$55.644 to $60.91M (Adjusted per ST-9)
138 kV Planning Deduct:	($12 M)
Eliminate Archer Trans.	($1.6M)
Total Project Costs:	**$42,044,000 to $47,310,000**

B. SCHEDULE

Q. HOW DOES THE TIMELINESS AND SCHEDULE OF THE EOTP PROJECT COMPARE WITH OTHER 138 KV AND 46 KV ALTERNATIVES?

A. Exhibit 101, page 3 of 4 provides a summary of construction schedules for the EOTP project as proposed, versus the Kamoku-Pukele 138 kV Underground Line (via Palolo) and the Kamoku 46 kV Underground Alternative. This summary shows that the estimated schedule for the 138 kV line could possibly

be completed by 2010. The Kamoku 46 kV Underground Alternative could possibly be completed in 2006 and the proposed project could be completed in 2008. These estimates were completed at the time of the Application's filing, so the estimates would certainly be impacted by the docket schedule being extended in this proceeding.

Q. WHAT RELEVANT FACTS SHOULD BE POINTED OUT IN THE COMPARISON FOUND ON HECO 101, PAGE 3, REGARDING CONSTRUCTION SCHEDULE COMPARISONS?

A. Both of the 46 kV alternatives are estimated to take between 1 and 1.5 years to complete the construction. The 138 kV alternative is expected to take between 1.5 and 2 years to complete. Although the amount of time to construct all three options is comparable (between 1 and 2 years overall), the completion dates are substantially different.

Q. WHY ARE THE CONSTRUCTION COMPLETION DATES SUBSTANTIALLY DIFFERENT AMONGST THE THREE ALTERNATIVES?

A. The difference in completion dates is attributed to the permitting and approval process variances between the alternatives. HECO T-6, pages 9-12 describes the permitting and approval process for the Kamoku-Pukele 138 kV Underground Alternative. In general, City permits, PUC approval and an EIS would all have to be completed and approved before construction. Of the

three alternatives, the Kamoku 46 kV Underground Alternative has the least number of major permits and approvals to must obtained (HECO T-6, page 13). This alternative would only require City permits and PUC approval. The Kamoku 46 kV Underground Alternative – Expanded permitting and approval is similar to the Kamoku 46 kV Underground Alternative with a few other considerations. HECO elected to complete a voluntary EA for the project (HECO T-6, page 16), and that there may be some structural issues installing underground ducts that cross drains on King Street, as well as traffic considerations, so City approvals may take longer than the other 46 kV alternative (HECO T-6, page 15).

Q. DO THE SCHEDULES PRESENTED BY HECO FOR THESE ALTERNATIVES APPEAR REASONABLE?

A. The schedules for the 46 kV alternatives appear reasonable. There is more uncertainty in the 138 kV project schedule. The recent EIS process and ultimate denial of the Kamoku-Pukele Underground Alternative (via Waahila Ridge) demonstrates that strong public opposition is anticipated for this or any 138 KV alternatives in this area. Therefore, the 138 kV schedule may be unrealistic.

The construction schedule for the EOTP 46 kV improvements as proposed has been modified since the time of the project Application. Supplemental testimony submitted by HECO modified the schedule for a

completion date of early 2009 due to the PUC hearing schedule and the EA review process. This increased the project schedule by approximately six months (HECO ST-6, page 4).

C. EFFECTIVENESS

Q. HOW DOES THE EFFECTIVENESS OF THE EOTP AS PROPOSED COMPARE WITH 138 KV AND OTHER 46 KV ALTERNATIVES CONSIDERED?

A. Exhibit HECO-101 and Table 5-1 from the *East Oahu Transmission Project Alternatives Study Update* (HECO, December, 2003) both accurately summarize the effectives of various project considered. As discussed in Section IV of my testimony, the instant EOTP effectively addresses the Koolau/Pukele Overload and Downtown Overload Situations. The instant EOTP as proposed also addresses the Pukele Reliability Concern and partially addresses the Downtown Reliability Concern. Only the Kamoku-Pukele 138 kV (2 options) and the School-Pukele 138 kV alternatives were found by HECO to be more effective than the proposed project.

Q. DOES THE CURRENT EOTP PROVIDE BENEFITS THAT THE 138 KV ALTERNATIVES DO NOT?

A. Yes. As previously discussed, the 46 kV EOTP as proposed provides a reliability advantage over 138 kV alternatives under certain circumstances

such as complete loss of a transmission substation. For example, there are certain problems at substations, which can lead to a complete loss of the substation, regardless of how many 138 kV lines are feeding that substation. In that case, if the 46 kV circuits fed from that substation do not have backup circuits from other substations, loss of load will occur (i.e., the Pukele Substation Reliability and Downtown Reliability Concerns).

Regardless of how many lines feed the Pukele Substation, there is a chance that the entire substation could be out of service. The 46 kV improvements of the EOTP, provides complete backup of the Pukele Substation, eliminating this concern of 138 kV events that could remove the substation from service. Installing a third 138 kV line to the Pukele Substation does not remove this concern. This again points to the importance of improving not only the transmission system, but the sub-transmission system as well.

Q. WHAT PROBLEMS AT A TRANSMISSION SUBSTATION CAN CAUSE A COMPLETE OUTAGE OF THE STATION REGARDLESS OF HOW MANY TRANSMISSION LINES FEED THAT STATION?

A. Examples such as breaker failures or bus faults could lead to catastrophic equipment failure inside the substation in a worst case, or the fault will be cleared best case (in clearing the fault, the substation will be isolated). A "breaker failure" means that the breaker could not clear a problem it sensed,

and usually the entire substation, or a large portion of the substation must be isolated so that catastrophic failure or loss of life (if a there is a downed line) is minimized. A "bus fault" can occur when equipment fails that is connected directly to the common bus inside of a substation. To remove this fault (failed piece of equipment), typically all breakers connected to that bus, which often translates into the entire substation, are cleared or isolated.

In these cases, the substation outage can be relatively short if there are ways to bypass the failed piece of equipment, to a very long time if there are not ways to bypass the equipment, or if major equipment damage has occurred.

Q. DO YOU AGREE WITH HECO'S COMPARISON OF ALTERNATIVES?

A. I do agree with the results of HECO's studies, but as previously stated, my conclusion is that HECO should have been improving the 46 kV system during the time period that they were planning the 138 kV Kamoku-Pukele Underground Alternative. Proper application of planning criteria and proper utilization of existing infrastructure did not occur during this time period. Therefore, a more accurate comparison is between the 46 kV alternatives.

In the case of comparing the 46 kV alternatives, I do find the EOTP as proposed to be the most effective project. Only the 46 kV Network Alternative provided similar effectiveness. Potential operational problems as discussed by HECO make the 46 kV Network Alternative less desirable.

D. ELECTROMAGNETIC FIELDS ("EMF")

Q. HOW DOES THE EMF LEVEL OF THE EOTP AS PROPOSED COMPARE WITH OTHER ALTERNATIVES?

A. Once again, these results are summarized on Exhibit HECO-101, page 4. It can be seen that the 46 kV alternatives create a greater EMF than the 138 kV alternatives. Depending upon the circuit configuration (See HECO T-10, page 13), the 46 kV circuits can have a level more than twice the 138 kV XLPE option.

Q. IS HECO DOING ANYTHING TO MITIGATE THE EMF LEVELS OF THE EOTP?

A. Yes, HECO if follows a policy of "Prudent Avoidance" (see HECO T-11, page 6), which the Commission adopted in its Decision and Order No. 13201.

Q. WHAT SPECIFICALLY IS HECO DOING TO REASONABLY PLAN FOR MITIGATION OF EMF EXPOSURE?

A. As pointed out on pages 14 and 15 of HECO T-10, HECO is arranging underground circuits in a manner that partially cancel fields from various conductors to minimize the EMF levels produced by the various circuit arrangements. It should be noted that the figures provided on HECO-101, page 4 are the mitigated EMF levels assuming optimum circuit arrangements.

Q. ARE THERE OTHER THINGS THAT HECO COULD DO TO MITIGATE THE EMF LEVELS OF THE EOTP?

A. Yes. The question becomes, however, whether or not these measures are "reasonable, practical, relatively inexpensive and simple to do so," consistent with the Commission's findings in Decision and Order No. 13201. For example, it could be possible to install the underground circuits in steel casing (or conduit), similar to the construction of the HPFF 138 kV line to further reduce the EMF levels produced by the 46 kV cables. However, it may not be reasonable, practical or inexpensive to do so. The project as proposed uses a large amount of existing underground ducts. These would all have to be dug up and replaced, which would increase the project cost significantly.

Q. DID YOU ESTIMATE THESE POTENTIAL COSTS TO INSTALL NEW STEEL CONDUIT DUCT BANKS?

A. No, I did not.

E. OTHER IMPACTS

Q. ARE THERE OTHER IMPACTS OF THE EOTP COMPARED TO THE OTHER ALTERNATIVES CONSIDERED THAT SHOULD BE POINTED OUT?

A. Yes, one impact that should be pointed out is how the various alternatives make use, or utilize existing infrastructure. Addition of 138 kV facilities, such

as the Kamoku-Pukele Underground Alternative (via Palolo or Waahila) add infrastructure to the existing 138 kV system. Sub-transmission projects such as those proposed in the instant docket utilize facilities already in place. While some additional sub-transmission facilities are needed to implement the project, existing facilities will be better utilized by better distributing loads amongst existing transmission substations (Archer, Kamoku and Pukele) and using transmission capacity that is not being utilized at this time.

Another impact worth mentioning is system outages. No matter what alternative is implemented, there is always a chance that outages will occur, be it isolated cases, or widespread loss of customer load. There is no such thing as 100% reliability. Outages and even blackouts, can and will, continue to occur on electric systems. Even the most robust electric system, such as the North American power grid, can sustain large loss of load and even blackouts, as noted in Mr. Pollock's testimony. It is important that utilities learn from these situations and continue to improve system reliability.

Q. MR. POLLOCK SUMMARIZES SEVERAL ELECTRICAL SYSTEM OUTAGES AND THE LESSONS LEARNED FROM THOSE OUTAGES ON PAGES 9 THROUGH 14 OF HIS TESTIMONY. DO YOU AGREE WITH MR. POLLOCK'S OBSERVATIONS REGARDING THE LESSONS LEARNED FROM THESE OUTAGES?

A. Yes, Mr. Pollock's summary statement on page 14 of his testimony correctly states, "outages that have a low probability of occurrence do in fact occur, and should not be minimized in the planning process. Rather, these 'less probable' outages must be addressed in planning studies."

Q. ARE THERE OTHER OBSERVATIONS THAT YOU WOULD LIKE TO ADD TO MR. POLLOCK'S OBSERVATIONS REGARDING THE LESSONS LEARNED FROM THE OUTAGES SUMMARIZED IN HIS TESTIMONY?

A. Yes. Other lessons that should be learned by these outages are:

1. Proper engineering, especially protective relay engineering is critical to system integrity. The Northeast Blackout of November 1965 began with operation of protective relays improperly set. The Western States Cascading Outage on December 14, 1994 involved an improper relay trip. The system wide blackout of Oahu on July 13, 1983 involved improper relay operation. Finally, the March 3, 2004 Pukele Substation Outage involved protective relay communication equipment improperly operating.

2. Proper right of way clearing and tree trimming is also crucial to system operations, especially under heavy load periods. The August 10, 1996 Western States Outage and the August 14, 2004 Northeast/Midwest US Blackout both involved transmission line contact with trees.

Planning for all of the "less probable" outages is an impossible task. Human error, nature and equipment failure will continue to cause power outages. An appropriate example of this is the July 13, 1983 system wide Oahu blackout. All of the events that occurred on that date could not have been planned for to avoid an outage. Both avoidable and unavoidable factors contributed to the blackout (this conclusion is based on Mr. Pollock's summation of the situation). Hurricane Iwa and a cane fire (assuming that the cane was not directly in the transmission line right of way) were unavoidable events. Relay mis-operation and improper instrument readings were perhaps avoidable. In any case, such combinations of events cannot be planned to avoid outages in all cases.

A recent article in the August 2004 IEEE Spectrum magazine titled *The Unruly Power Grid* discusses the fact that large outages can and will continue to occur despite best efforts of planning engineers. Moreover, the frequency of larger blackouts occurs more than common statistical methods predict. A copy of this article is attached to my testimony as Exhibit CA-113.

F. PUBLIC SENTIMENT

Q. HOW DOES THE PUBLIC SENTIMENT OF THE EOTP AS PROPOSED COMPARE TO OTHER ALTERNATIVES?

A. HECO-101, page 4 indicates that the Kamoku-Pukele 138 kV Underground Alternative (via Palolo) faces strong opposition, while the two 46 kV Underground Alternatives face "somewhat less opposition."

Q. HOW DID HECO MAKE THIS ASSESSMENT OF PUBLIC SENTIMENT?

A. HECO instituted a Community Advisory Committee ("CAC") to gather public input regarding the three alternatives, as explained on pages 3 through 5 of Mr. Alm's testimony (HECO T-12). A series of meetings was conducted and summarized in a report created by 3Point Consulting called *East O'ahu Transmission Project, A Report on Public Input Collected in June and July 2003* (September 2003)

Q. DO YOU CONTEND THAT THE ASSESSMENT OF PUBLIC SENTIMENT BY HECO AS SUMMARIZED ON HECO-101, PAGE 4 IS ACCURATE?

A. Not entirely. What HECO-101 does not point out is that there is strong opposition to all three alternatives. Mr. Alm does acknowledge this in his summary of CAC issues on HECO T-12, Page 6.

Page 12 of the 3Point Consulting report called *East O'ahu Transmission Project, A Report on Public Input Collected in June and July*

2003 (September 2003), which is also page 15 of Exhibit 11 to the Application in this docket, points out three dominant themes;

- The EOTP is not needed
- Strong opposition to the 138 kV alternative
- Criticism of the CAC meeting locations

The third item above has no impact on project alternatives comparison. The first two dominant themes are relevant and indicate that the project is strongly opposed. Also, opposition of the 138 kV alternatives is not equivalent to support of 46 kV alternatives. As pointed out on page 17 of the 3Point report, "It should be emphasized that this opinion theme is not equivalent to a preference for any of the 46 kV options."

Q. WHAT DO YOU CONCLUDE ABOUT THE PUBLIC SENTIMENT AS IT RELATES TO COMPARING THE VARIOUS 46 KV AND 138 KV ALTERNATIVES?

A. Public sentiment appears to simply be that they do not see a need for the project, no matter what the operating voltage. This may or may not be due to a lack of understanding regarding the differences between the 138 kV and 46 kV options.

G. THE PUBLIC WELFARE IN GENERAL

Q. HOW DOES THE EFFECT ON THE PUBLIC WELFARE IN GENERAL OF THE EOTP AS PROPOSED COMPARE TO OTHER ALTERNATIVES?

A. I believe the EOTP as proposed will have a more positive benefit to the public welfare than other 138 kV and 46 kV alternatives considered in this docket.

Q. WHY DO YOU CONCLUDE THAT THE BENEFITS OF THE EOTP AS PROPOSED WILL BE MORE BENEFICIAL TO THE PUBLIC WELFARE THAN OTHER ALTERNATIVES CONSIDERED?

A. The EOTP provides reliable electricity to customers in east Oahu at a lower cost than the 138 kV alternatives considered. This reduces HECO's electricity cost and ultimately the customer's electric bill. The EOTP as proposed, though more expensive than the other 46 kV alternative considered in this docket, provides a much greater benefit of increasing the reliability of important Waikiki and other east Oahu customers.

Another advantage of the ETOP as proposed is that the project does not require the use of Conservation District land and is more aesthetically pleasing than an overhead transmission line. This benefit has grown to be more important in recent years in Hawaii and on the mainland. As the reliance on electricity and the expectation of uninterrupted electric service continue to increase, coupled with the requirement to be visually pleasing (or unobtrusive),

this project should help satisfy those public expectations and provide a greater benefit to the public welfare in general.

Q. ARE THERE AREAS WHERE THE BENEFITS TO THE PUBLIC WELFARE IN GENERAL ARE LESS FOR THE ETOP AS PROPOSED COMPARED TO OTHER PROJECTS?

A. Yes, the impact of EMF. EMF levels are higher for the 46 kV alternatives compared to the 138 kV alternatives. While, there is still no conclusive evidence that EMF from transmission/subtransmission lines poses a serious health risk, the general public has concerns about this issue. Therefore, the concern, real or perceived, regarding EMF levels of the 138 kV alternative provides a benefit to the public welfare in general that the 46 kV alternatives do not. However, 138 kV alternatives also are a source of EMF, only at lower levels. Just as there is no conclusive evidence that EMF exposure poses a serious health risk, there is no conclusive evidence as to what level is dangerous.

VIII. COMPARISON OF EOTP WITH NON-TRANSMISSION OPTIONS

Q. DID YOU COMPARE THE EOTP WITH OTHER NON-TRANSMISSION ALTERNATIVES?

A. Yes, consistent with Issue No. 4 of Order No. 20968, I reviewed the HECO comparison of the EOTP to other non-transmission alternatives. My

comparison consisted of reviewing relevant studies and documents[7] related to DG, CHP, DSM/LM programs and alternative generation sources.

Q. WHAT WERE THE NON-TRANSMISSION ALTERNATIVES TO THE EOTP CONSIDERED BY HECO?

A. Numerous options were considered that can be grouped into DSM, generation related alternatives (supply-side management), and other alternatives such as "live line" maintenance and line re-rating/tensioning. Demand side alternatives include options such as commercial efficiency programs (i.e., encouraging high efficiency equipment installation), residential water heating programs, CHP and revisions to load forecasts. Generation alternatives included renewable resources (e.g., wind, hydro, solar, battery, fuel cells, etc.), larger scale generation plants such as combustion turbines and base load plants, renovation of the Honolulu Power Plant and distributed generation options. Other alternatives included line uprating, re-rating and live line maintenance.

Q. HOW DOES THE EOTP COMPARE AGAINST THESE VARIOUS ALTERNATIVES?

A. Table 4-1, of the *East Oahu Transmission Project: Options to the Koolau/Pukele Transmission Line Problem* (HECO, December, 2003), which is

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[7] Relevant studies included the *Kamoku-Pukele 138-kV Transmission Line Alternatives Study* (CH2M Hill, June 1995), and the *East Oahu Transmission Project: Options to the Koolau/Pukele Transmission Line Overload Problem* (HECO, December 2003).

included as page 63 of Exhibit 6 of HECO's Application summarizes the results of HECO's comparisons. In general, none of these alternatives can address all of the problems as effectively as the EOTP. Implementation of DG, DSM/LM, or CHP could potentially solve the Koolau/Pukele Overload Situation. Costs of such projects ranged from $50 million to $83 million. These projects would not address the remaining EOTP concerns.

Additionally, HECO concludes that an aggressive DSM/LM program could also potentially solve the Downtown Overload Situation as well (HECO T-4, page 67). However, the potential of non-transmission options to solve transmission overload and reliability issues are not nearly as great as the EOTP.

Q. HOW DID HECO COME TO THESE CONCLUSIONS?

A. HECO utilized CH2M HILL to complete a 1995 study titled *Kamoku-Pukele 138-kV Transmission Line Alternatives Study*. HECO later completed a similar updated study entitled the *East Oahu Transmission Project: Options to the Koolau/Pukele Transmission Line Overload Problem* (HECO, December, 2003). These studies looked at the above described options to solve the transmission system constraints. The later study (HECO 2003) also looked into just solving the Koolau/Pukele overload problem.

In the 1995 CH2M HILL study, options were compared and weighed with the input of the CAC. Results of that study comparison ranked options

such as DSM and 46 kV options ahead of the Kamoku-Pukele 138 kV transmission line options. However, CH2M HILL concluded that the 138 kV transmission line between Kamoku and Pukele was the best alternative for solving system constraints (page 6-5 of the CH2M study).

The HECO 2003 study concluded that none of the options considered could address Pukele Substation Reliability Concern (page ES-1 of HECO study). Various demand side management, load management and distributed generation options could not eliminate the Koolau/Pukele Overload Situation (Table 4-1 of HECO study). HECO also concluded that live-line maintenance was not viable due to weather conditions and limited access to the lines in the Koolau mountain range (page 4 of HECO report). This conclusion was based upon a study completed by Energy Data Management, Inc. in 2002.

Q. DO YOU AGREE WITH HECO'S CONCLUSIONS THAT COMPARE THE EOTP AS PROPOSED WITH VARIOUS NON-TRANSMISSION OPTIONS?

A. I agree that "non-transmission" options cannot, in and of themselves, solve all of the system constraints at this time. I also agree that demand side and supply side programs such as load management and load control programs and CHP and DG projects can solve the system overload problems. Unfortunately, these programs cannot be implemented quickly enough to eliminate reliability concerns pertaining to the Pukele Subsection. Even if the costs to pursue and implement the measures are uncertain at this time since

much of the DG technology is quite new. I would like to point out that all of these options should continue to receive review and refocus as technology improves and as costs of such technologies declines.

Q. ARE THERE ELEMENTS OF HECO'S COMPARISON OF THE EOTP AND NON-TRANSMISSION ALTERNATIVES THAT YOU DO NOT AGREE WITH?

A. Yes. HECO assumes that only 47 MW of DSM, LM, CHP or DG and other generation could be implemented (See page 3 of the Executive Summary of the HECO study). This is a short-sighted estimate in my opinion since neither the HECO DG nor CHP programs have received approval at this time. In addition, such programs may generate interest and the ability to install a greater level of generation than the 47 MW assumed by HECO is likely. If aggressive DSM programs are coupled with aggressive CHP and/or DG programs, the potential is much greater than 47 MW, but still unknown at this time.

Given that CHP/DG programs are in the early stages of development, that costs are uncertain, and that an implementation schedule is not in place, the non-transmission options to the EOTP cannot offer similar benefits as the project proposed at this time. Assuming that the EOTP is proposed in the instant docket is implemented and that CHP/DG and DSM programs are all actively pursued, perhaps future non-transmission options will compare more favorably to transmission improvements proposed in the future.

Q. WHAT DO YOU CONCLUDE REGARDING THE COMPARISON OF NON-TRANSMISSION ALTERNATIVES VERSUS THE IMPROVEMENTS PROPOSED IN THE INSTANT DOCKET?

A. I conclude that the EOTP as proposed is favorable over the non-transmission only options at this time. The primary reason for this conclusion is the uncertainties associated with the cost, schedule and implementation of non-transmission programs such as DG/CHP. I further conclude that such programs have good potential for being viable options in future proceedings as DG technology improves and costs decline.

IX. PLACEMENT OF 46 KV FACILITIES BELOW THE SURFACE

Q. HAVE YOU REVIEWED THE EOTP FACTORS LEADING HECO TO PROPOSE AN ALL-UNDERGROUND ALIGNMENT FOR THIS PROJECT?

A. Yes, the fifth and final Statement of Issues in Order No. 20968 requires a project review, "Pursuant to the requirements of HRS 269-27.6(a), whether all (as proposed by HECO) or part of the 46kV lines that are part of HECO's East Oahu Transmission Project should be placed, constructed, erected or built below the surface of the ground?"

Q. BRIEFLY, WHAT ARE HECO'S REASONS FOR PROPOSING AN ALL-UNDERGROUND ALIGNMENT?

A. The reasons vary depending upon which portion of the route is examined. The following summary provides a listing of the primary reasons for undergrounding in various segments of the project.

Phase 1: Makaloa to McCully Circuits (HECO T-7, page 3)

1. Existing 46 kV circuits between these two substations are all underground.
2. An existing underground duct line may be used to install the new 46 kV circuits.
3. There is potential for delays/additional cost if overhead alignments are pursued.
4. Engineering and construction constraints (i.e., space constraints at the two substations).
5. Applicable City ordinances (Section 14-22.1, ROH).
6. Alternative routes have greater disadvantages (i.e., no existing duct lines, more traffic, etc.) (HECO T-7, pages 7 and 8).

Phase 1: Remaining 46 kV Connections (HECO-pages 8 through 10)

1. Short segments of facilities from the Kamoku Substation to existing Pukele circuits must be placed underground since the Kamoku Substation is enclosed (i.e. all underground circuits).

2. The incremental cost to install the Pumehana Street to Date Street and Winam Ave. to Mooheau Avenue segments underground is relatively small given the potential for opposition to overhead circuits.

Phase 2: King Street Ductline (HECO T-7, pages 10 to 13)

1. Archer Substation is designed for underground circuits to and from the substation.
2. Approximately one third of the route requires undergrounding due to several State and City laws or rules.
3. There are currently no overhead electric lines on King Street from Cooke Street to McCully Street. Visual impact of new overhead lines could be significant and may be opposed.
4. An overhead alignment on King Street may be subject to City Ordinance (14-22.1, ROH), which may require the underground placement of the lines.
5. Alternate routes along Young Street and Beretania Street face similar impediments to overhead lines and may have other issues such as more traffic control and longer routes of the circuits, tree issues, etc.

Q. HAVE YOU REVIEWED THE PROJECT ROUTING AS IT RELATES TO THE PROPOSED EOTP?

A. Yes. On August 9, 2004, HECO company representatives provided a tour of the selected routing and alternate routing. I also independently reviewed the routing areas of the proposed improvements.

Q. DO YOU AGREE WITH THE COMPANIES REASONING FOR SELECTING AN ALL-UNDERGROUND ALTERNATIVE FOR PHASE 1 OF THE EOTP?

A. Yes, except for two small segments. During my site visit, it was noted that most of the selected and alternate routes are highly urbanized areas where structures are well established. Regarding Phase 1 improvements, the existence of underground circuits along much of the proposed route and the fact that existing 46 kV circuits between Makaloa and McCully substations are already underground lends itself to pursuing an underground route. HECO also intends to utilize existing ducts that are already in place underground. In addition, Kamoku Substation is totally enclosed and underground construction of 46 kV circuits from Kamoku is logical.

During my visit I noted that overhead circuits in the areas of Pumehana Street to Date Street and Winam Ave. to Mooheau Avenue already exist. The Company is proposing to connect these existing overhead circuits with segments of underground where neither overhead nor underground lines exist presently. Both proposed segments would be very short underground

sections. The incremental cost of underground versus overhead for these segments is estimated to be $408,000. Based on my site visit, however, it appears that overhead lines in this area could be pursued.

Q. DO YOU AGREE WITH THE COMPANIES REASONING FOR SELECTING AN ALL-UNDERGROUND ALTERNATIVE FOR PHASE 1 OF THE EOTP?

A. Yes I do. For Phase 2, Archer Substation is designed for underground 46 kV circuit exits, so it is logical to have circuits from Archer substation at least begin as underground circuits. The selected route along King Street appears reasonable compared to other alternatives. Since at least one third of the route likely has to be underground and the remaining portion of the route might be subject to City ordinances requiring undergrounding, an all-underground route is logical. The lack of existing overhead lines along certain portions of the route on King Street also is a factor since installing overhead lines in this segment may face some resistance.

Q. WHAT IS YOUR CONCLUSION REGARDING THE PROPOSED ALL UNDERGROUND ROUTE OF THE EOTP 46 KV LINES?

A. I agree that the selected route proposed as underground is reasonable. However, as already mentioned, the segments between Pumehana Street to Date Street and Winam Ave. to Mooheau Ave. could possibly be constructed as overhead since there are existing overhead lines in the area. Thus, the

visual impacts of installing these segments on overhead versus in underground facilities is not as great as if there were no existing overhead lines in the vicinity.

Q. DO YOU RECOMMEND THAT THE COMPANY CONSTRUCT THE PUMEHANA STREET TO DATE STREET AND WINAM AVE. TO MOOHEAU AVENUE SEGMENTS AS OVERHEAD OR UNDERGROUND 46 KV CIRCUITS?

A. I recommend that the Company at look further into this option since it has the potential of saving ratepayers $408,000. As a result, the company should investigate construction of these very short segments on overhead facilities before proceeding with proposed underground placement of these lines.

IX. SUMMARY OF TESTIMONY

Q. DO YOU HAVE A SUMMARY STATEMENT YOU WOULD LIKE TO PROVIDE TO THE COMMISSION REGARDING THIS PROCEEDING?

A. Yes, I recommend that the EOTP as proposed, be approved by this Commission subject to various cost adjustments and planning requirements as provided in my testimony. Installation of the EOTP meets the goals of HECO to provide reliable electric service at a reasonable cost. These improvements are needed to solve system constraints and the project is preferred compared to various transmission and non-transmission alternatives considered.

Q. WHAT ARE YOUR SPECIFIC IMPORTANT CONCLUSIONS PRESENTED IN YOUR TESTIMONY?

A. Conclusions reached in my testimony that should be pointed out are:

- HECO did not properly plan or apply proper planning criteria when pursuing the Kamoku-Pukele 138 kV Underground Alternative (via Waahila Ridge).
- HECO's transmission system and transmission substation transformers have adequate capacity to supply projected HECO load through 2022.
- System improvements are needed in the near term on the 46 kV subtransmission system to redistribute load amongst the transmission substations of Pukele, Archer and Kamoku, which will better utilize the HECO electric system and mitigate the Pukele and Downtown Reliability concerns.
- 46 kV improvements proposed in the instant docket are consistent with proper planning and utilization of the HECO electric system.
- The EOTP as proposed is preferable to other 138kV and 46 kV alternatives presented in this proceeding.
- The EOTP as proposed is preferable to non-transmission alternatives presented in this proceeding.
- Pursuant to the requirements of HRS 269-27.6(a), all except two short segments of the 46kV lines that are part of HECO's East Oahu

Transmission Project should be placed, constructed, erected or built below the surface of the ground.

- The costs of the EOTP are reasonable in development but improperly include costs for 138 kV planning, for a 138/46 kV 80 MVA transformer at Archer Substation that is not necessary, and for portions of the 46 kV lines that should be constructed as overhead lines.

Q. PLEASE SUMMARIZE YOUR RECOMMENDATIONS.

A. My testimony recommends that the improvements proposed by HECO in the instant docket known as the EOTP be approved in part, with the following adjustments and conditions:

1. The estimated project cost ranging from $55,644,000 to $60,910,000[8] be reduced by $12 million (i.e., $43,644,000 to $48,910,000) to remove the costs associated with planning, public scoping and input, routing selection, environmental review and CDUP processes during the period from 1991 through June 2002. This recommendation is based on points in my testimony that show HECO should have been focusing on

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[8] On December 18, 2003, HECO filed an application requesting commission approval to, among other things, commit approximately $55,424,000 for Item Y48500, East Oahu Transmission Project, in accordance with paragraph 2.3.g.2 of the commission's General Order No. 7, Standards of Electric Utility Service in the State of Hawaii ("proposed project"). Supplemental testimony adjusted this figure to a range of $55,644,000 to $60,910,000 to include the costs associated with routing changes and possible additional street paving. (HECO ST-9, page 7.)

implementing 46 kV projects during that time period, consistent with its own planning criteria.

2. The EOTP project cost should be further reduced by $1.6 million (i.e., $42,044,000 to $47,310,000) to remove the costs for equipment proposed in the EOTP that is not necessary. Specifically, the 138/46 kV, 80 MVA transformer proposed to be installed at Archer Substation as part of Phase 2 of the Kamoku 46 kV Underground Alternative – Expanded is not necessary for the project to provide the intended benefits.

3. The project cost should be reduced by $408,000 for certain proposed underground 46 kV segments, namely, the Pumehana Street to Date Street and Winam Ave. to Mooheau Avenue segments, which could be constructed as overhead segments, pursuant to HRS § 269-27.6(a).

4. HECO should be required to expense the costs incurred, including the accrued AFUDC on such project costs, to pursue the Kamoku-Pukele 138 kV Underground Alternative.

5. When new transmission projects are pursued by HECO, the Company should be required to first demonstrate that appropriate distribution and sub-transmission projects have been implemented on a "best efforts" basis to fully utilize existing infrastructure.

6. The IRP process should be updated to include a provision that requires the Company to include the impacts of transmission and

sub-transmission projects upon supply-side planning, consistent with HECO transmission planning criteria.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. YES IT DOES.